CERES QUALITY ASSESSMENT

QA Workshop - Boulder
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Definitions

Quality Assessment (QA)

- Emphasis is on correctly producing the data
- Occurs for every instance of every data product throughout production
- Effort and responsibility cross science and production boundaries
- Occurs within a near-time window
- First step in data validation

Validation

- Emphasis is on verifying that the algorithms are producing correct results
- Involves only small subsets of the overall data set
- Mainly a Science Team effort and responsibility
- Longer term effort
- Typically done with earlier data sets
- Involves comparison with other data sources or methods

CERES QA Lessons Learned

- **QA is evolutionary**
- **Need mechanism to sufficiently communicate QA and Validation information**
- **Can improve upon QA processes, even mature processes**

CERES QA Maturity

CERES has data products at all levels of maturity

Maturity based on

- Data product maturity
- Experience of personnel
- Data analysis with view to better engineer future efforts
- Product complexity
- Staffing and priorities

CERES QA Maturity Lifecycle

Early on

- Look at everything, unclear what is important
- Very labor/time intensive
- Realization that can’t continue this level of effort

Familiar with data

- Know approximately what to look for
- Generate summary reports and snapshots
- Reduce labor/time, but still taking fair amounts

Large volume of data

- Too difficult to compare individual summaries
- Add monthly/yearly trending of summary parameters
- Combine or compare multiple instrument summaries

CERES QA Maturity Lifecycle (cont.)

Iterate on QA outputs/procedures as needed to reduce labor/time

Automate the expert

- Final step
- Can only be done based on huge amount of experience
- Determine rules for checks performed by expert
- Create expert system to automate those checks and notify appropriate party when anomaly occurs
- Minimal labor/time

Examples of CERES Data Products at varying QA Maturity Levels

Immature: SSF (Single Scanner Footprint) product

- New research product
- QA poorly defined and very labor intensive
- Still in early phase

Mid-level Maturity: BDS (BiDirectional Scan) product

- Several years of experience with product
- QA well thought out but heavily relies on “person in the loop”
- Iterating on QA outputs/procedures

Most Mature: ES-8 (ERBE-like Instantaneous TOA) product

- Highly automated QA; minimal human intervention
- 15+ year of experience with product
- In second iteration of “automate the expert”

SSF

Level 2 data product

Produced in coordination/cooperation with 3 Working Groups

- Each working group has own science and programming staff
- Coordinating across working groups more difficult
- Easy for working groups to be isolated from each other
- Emphasis of most working groups is Science

Majority of staff not experienced in production type processing

New, complex research product

- Huge product; ~200 MB/scanner hour
- Poorly defined; some parameters still moving targets

Current focus Science and algorithms

- Little attention to QA; too early?? less interest??

Publically available SSF QA: http://earth-www.larc.nasa.gov/ssf/pub_ssf

BDS

Level 1b data product

Produced by single Working Group

Well staffed; resources not an issue

- Majority of staff not experienced in production type processing
- Lots of on the job training
- Staff consists mainly of programmers and engineers

High visibility product on which all others depend

- Huge pressure to produce high quality product

Mature Engineering product; little Science

- QA given high priority

Publically available BDS QA: http://lposun.larc.nasa.gov/ceresweb/instr_pub.html

ES-8

Level 2 data product

Produced by single Working Group

Very experienced staff

- Minimal staffing not an issue
- Science and programming staff work together closely

High visibility product

Mature Science product; based on ERBE heritage

QA given high priority

- Evolved several steps beyond ERBE

Examples of ES-8 QA outputs

- Formatted data dumps and QC summaries
- Trend plots and images
- E-mail message from automated expert

Publically available ES-8 QA: http://earth-www.larc.nasa.gov/erbelike/pub_cdval

RECORD NUM =	1	2	3	4	5	6	7	8	9	10
Julian Day										
XREC(1)	2450818.00	2450818.00	2450818.00	2450818.00	2450818.00	2450818.00	2450818.00	2450818.00	2450818.00	2450818.00
Julian Time										
XREC(2)	0.500057707	0.500134096	0.500210484	0.500286873	0.500821596	0.500974374	0.501203542	0.501585486	0.501661875	0.501738264
Earth-Sun Distance										
XREC(3)	0.983293407	0.983293407	0.983293407	0.983293407	0.983293408	0.983293408	0.983293408	0.983293408	0.983293408	0.983293408
Spacecraft Position, x										
XREC(4)	-5621948.00	-5639141.50	-5656055.00	-5672688.50	-5781195.00	-5809623.00	-5850097.00	-5911722.50	-5923166.50	-5934315.00
XREC(5)	-5639115.50	-5656030.00	-5672663.50	-5689016.00	-5795531.50	-5823384.00	-5862988.50	-5923149.50	-5934298.50	-5945152.00
Spacecraft Position, y										
XREC(6)	1235107.88	1191918.13	1148676.88	1105386.50	801158.13	713917.69	582858.06	364042.28	320241.56	276433.47
XREC(7)	1191983.63	1148742.50	1105452.13	1062114.63	757618.75	670321.63	539193.69	320307.97	276499.91	232686.67
Spacecraft Position, z										
XREC(8)	3468197.50	3455413.75	3442432.00	3429252.75	3331534.75	3301883.00	3255987.75	3175772.75	3159179.50	3142405.00
XREC(9)	3455433.25	3442452.00	3429272.75	3415897.25	3316826.50	3286796.00	3240338.50	3159204.75	3142430.75	3125476.25
Spacecraft Velocity, x										
XREC(10)	-2716.25	-2670.80	-2625.23	-2579.51	-2255.67	-2162.02	-2020.66	-1782.80	-1734.94	-1686.97
XREC(11)	-2670.87	-2625.30	-2579.58	-2533.73	-2208.98	-2115.09	-1973.38	-1735.01	-1687.05	-1638.99
Spacecraft Velocity, y										
XREC(12)	-6949.84	-6959.06	-6967.92	-6976.44	-7026.11	-7037.12	-7050.95	-7066.89	-7069.00	-7070.77
XREC(13)	-6959.05	-6967.91	-6976.42	-6984.58	-7031.78	-7042.07	-7054.84	-7069.00	-7070.76	-7072.17
Spacecraft Velocity, z										
XREC(14)	-1921.87	-1951.96	-1981.93	-2011.78	-2217.46	-2275.10	-2360.58	-2500.35	-2527.88	-2555.25
XREC(15)	-1951.91	-1981.88	-2011.73	-2041.47	-2246.30	-2303.68	-2388.76	-2527.84	-2555.21	-2582.44
Spacecraft Nadir, Colatitude										
XREC(16)	58.93	59.06	59.19	59.32	60.28	60.57	61.02	61.80	61.96	62.12
XREC(17)	59.06	59.19	59.32	59.45	60.43	60.72	61.17	61.96	62.12	62.29
Spacecraft Nadir, Longitude										
XREC(18)	167.61	168.07	168.52	168.97	172.11	172.99	174.31	176.48	176.91	177.33
XREC(19)	168.06	168.52	168.97	169.42	172.55	173.43	174.75	176.90	177.33	177.76

ERBE-LIKE INVERSION PROCESSING SUMMARY

CERES PRODUCT: EQC-7
DATE PROCESSED: 1998/09/29 17:43:03
SATELLITE: TRMM
TEMPORAL SPAN: 1998/01/05 0000 - 1998/01/05 2359
INSTRUMENT: PFM-FAPS+RAPS
SYSTEM RELEASE: 2
CHANNEL: ALL
SOFTWARE VERSION: 7
UNITS: VARIOUS
DATA ALTITUDE: TOA

ORBIT AND DATA

		BLACKOUT START(TIME COLAT LONG)	STOP(TIME COLAT LONG)	LENGTH
NUMBER OF RECORDS	12733	17 42 54.43 98.3 123.6	18 18 39.44 62.6 258.6	35.75
PERCENT FULL RECORDS	97	18 18 46.04 62.7 259.0	18 20 51.44 66.2 266.8	2.09
CROSS TRACK RECORDS	4	0 0 31.39 59.4 169.4	0 1 10.99 60.3 172.1	0.66
RAPS RECORDS	12729	0 1 50.59 61.2 174.7	0 2 16.99 61.8 176.5	0.44
ALONG TRACK RECORDS	0	0 1 30.79 60.7 173.4	0 1 43.99 61.0 174.3	0.22
TRANSITIONAL RECORDS	0			
COMPUTER TIME (MIN)	5			
WALL TIME (MIN)	5	NO. OF DATA BLACKOUTS		6

		OPENED	CLOSED NORMAL	CLOSED FINAL	MAX REMAIN
ACTIVE 2.5 REG		13678	13566	112 139	0

OUTPUT TO DAILY	YES
OUTPUT TO ES8	YES

NO. OF SCAN SCENE IDENTIFIED UNKNOWN	44346
NO. OF SCAN EST REJECTED ON RAPID RETRACE	276797
NO. OF SCAN EST REJECTED ON MIN ALBEDO (0.02)	0
NO. OF SCAN EST REJECTED ON MAX ALBEDO (1.00)	2354
NO. OF LW SCAN EST REJECTED ON MIN RAD EX(50.00)	0
NO. OF LW SCAN EST REJECTED ON MAX RAD EX(400.00)	0
NO. OF SCAN MEAS REJECTED ON MAX VIEW ZEN(70.00)	430781
NO. OF SCAN MEAS REJECTED ON MAX BIDIRECT(2.00)	43770
NO. OF SCAN MEAS REJECTED ON ID SIGMA (8.00)	576
NO. OF SCAN MEAS REJECTED ON CONSISTENCY (10.00)	0
BAD SCANNER RECORD LEVEL FLAGS	0

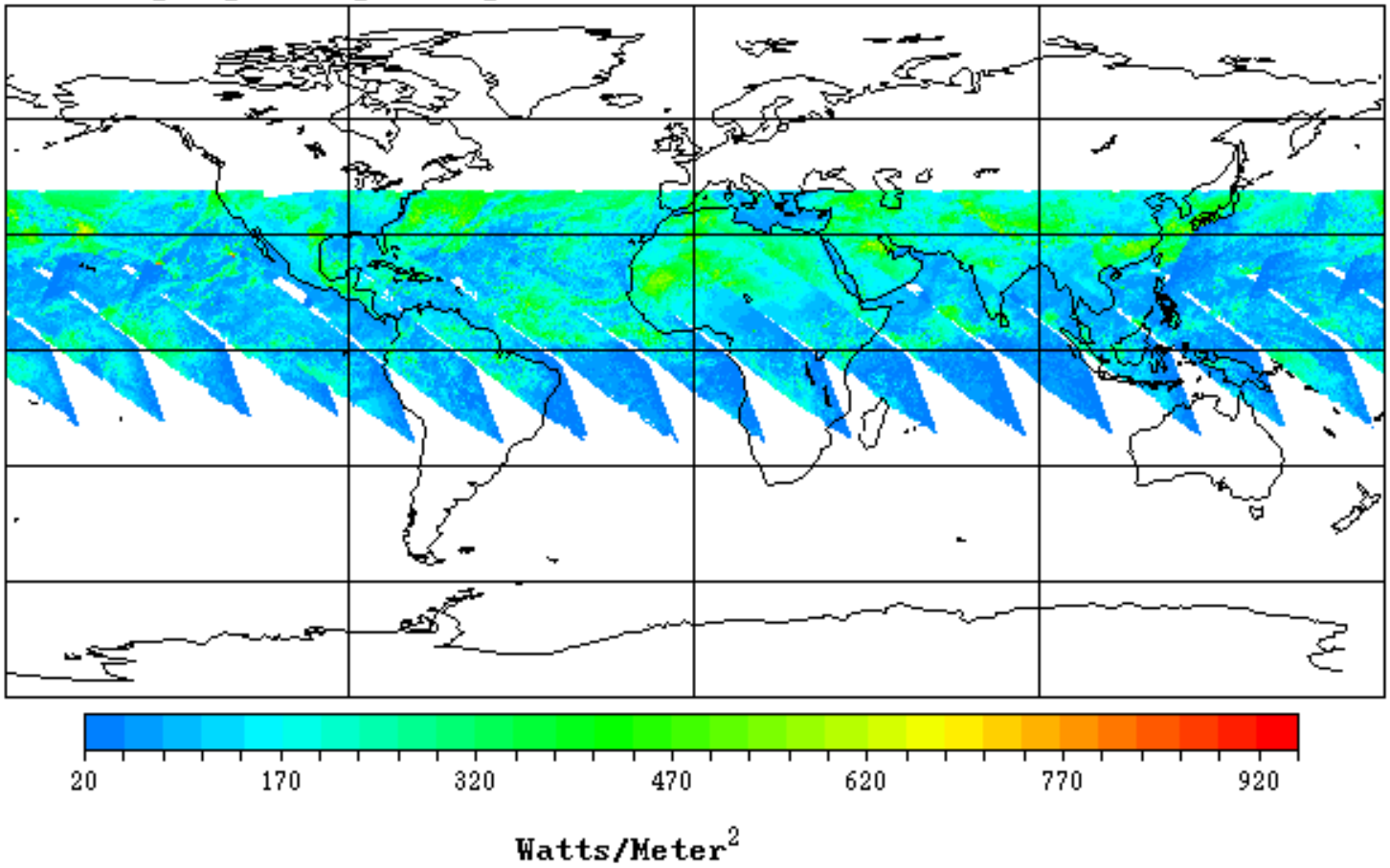
EARTH SPIN (DEG/SEC)	0.004178
SOLAR CONSTANT (W/M**2)	1365.000000
ALTITUDE TOA (KM)	30.000000
RADIUS OF EARTH (KM)	6371.315000
PI	3.141593
DEG TO RAD CONVERSION	0.017453
RAD TO DEG CONVERSION	57.295780
SEMI-MAJOR AXIS	6726.651954
ECCENTRICITY	0.001053
ARGUMENT OF PERIGEE	92.716329
TRUE ANOMALY	23.096853
INCLINATION	34.980301
LONG OF ASCENDING NODE	47.053834
ORBITAL PERIOD	91.507788
BETA ANGLE (DEG)	-44.013520
MAXIMUM COLAT (DEG)	134.869110
MINIMUM COLAT (DEG)	44.938599

Shortwave TOA Flux from CERES ERBE-like Processing

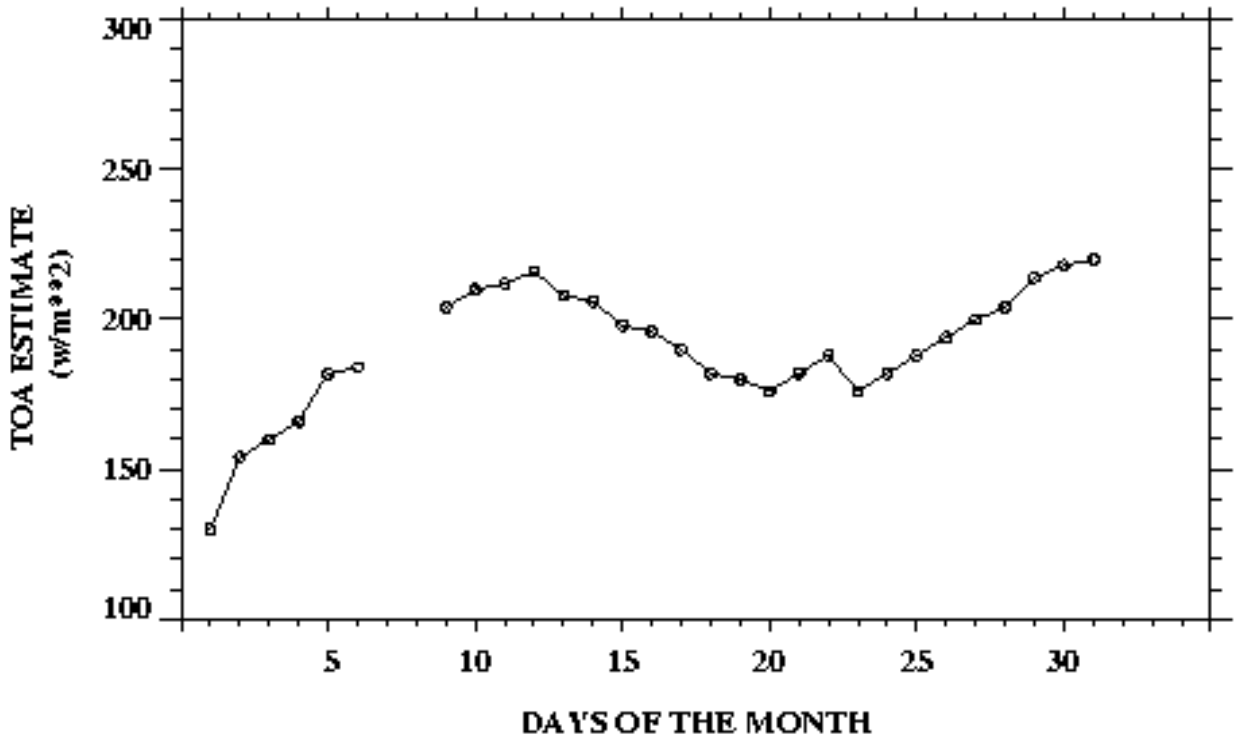
TRMM-PFM January 01, 1998 ES-8

Processed : 2000/04/05 Measurement Level Instantaneous

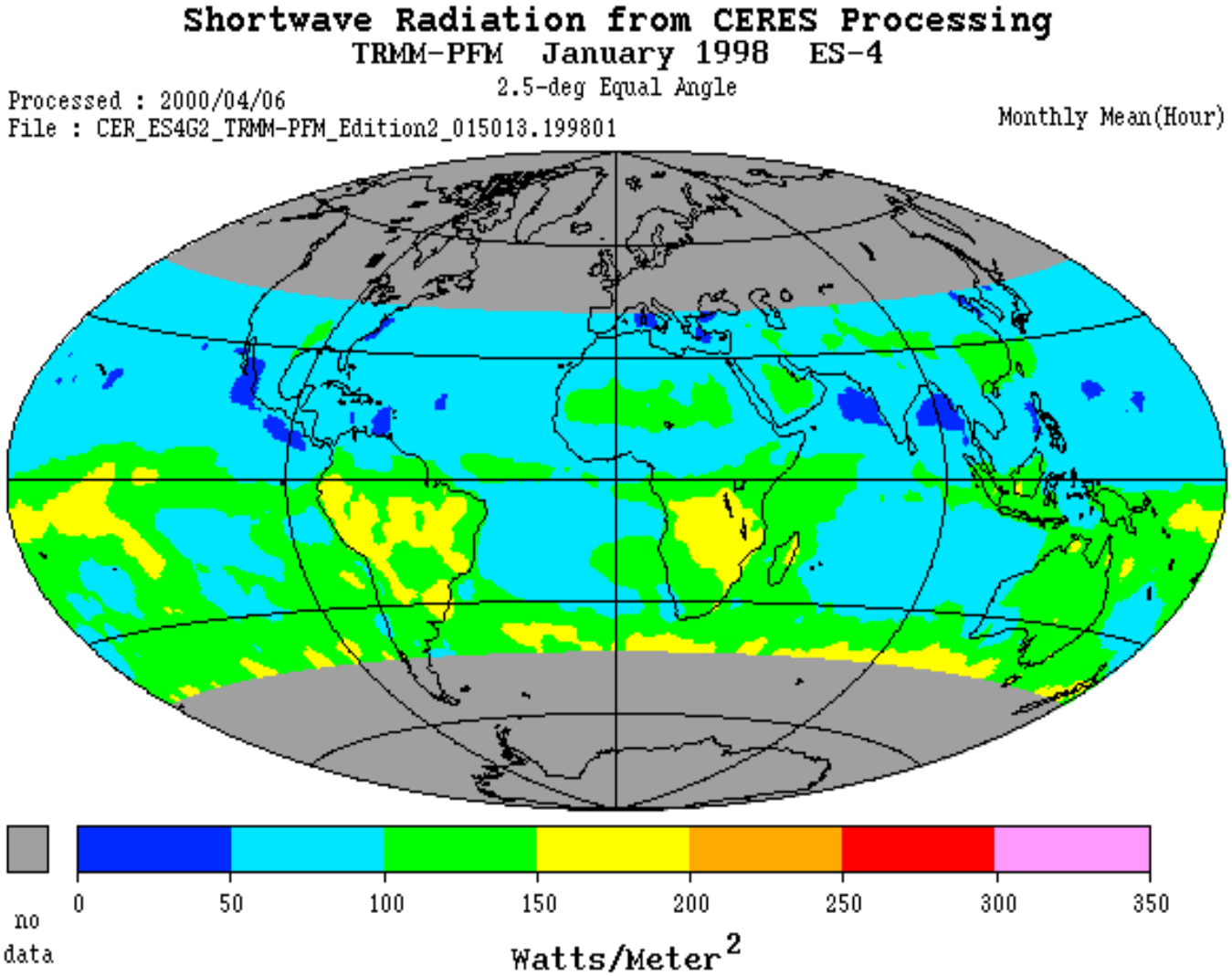
File : CER_ES8B_TRMM-PFM_Edition2_017013.19980101 00:00 - 23:21

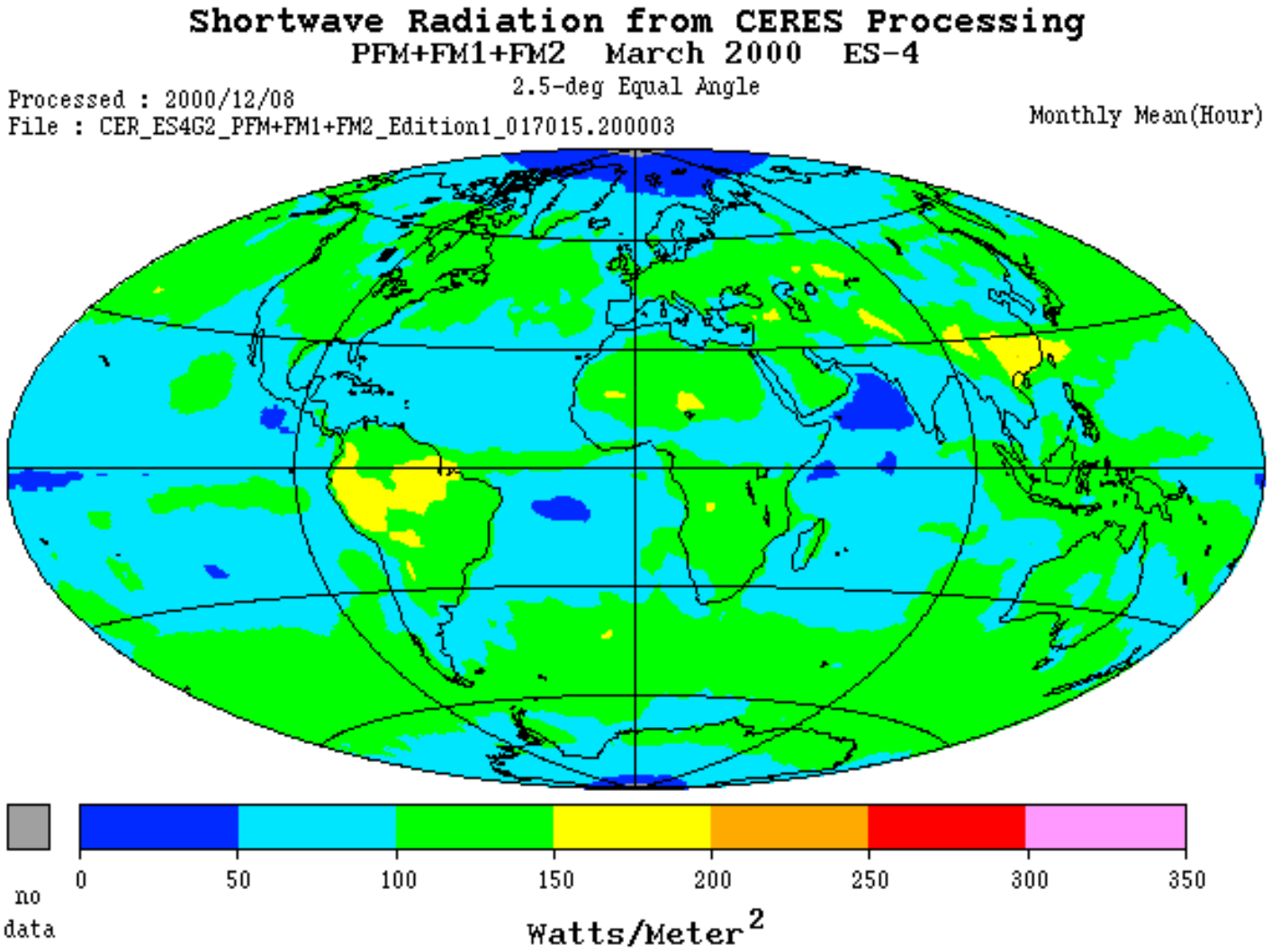


DAILY AVERAGES



SATELLITE	: TRMM PFM-FAPS+RAPS	**DATA DATE**	: JAN 1998
INSTRUMENT	: SCANNER	**PROCESSING DATE**	: 04/05/2000 - 04/05/2000
CHANNEL	: SHORTWAVE	**PLOT GENERATION DATE**	: 03/14/2001


Shortwave Radiation from CERES Processing
TRMM-PFM January 1998 ES-4
2.5-deg Equal Angle
Processed : 2000/04/06
File : CER_ES4G2_TRMM-PFM_Edition2_015013.199801
Monthly Mean(Hour)
no data
0
50
100
150
200
250
300
350
Watts/Meter2


Shortwave Radiation from CERES Processing
PFM+FM1+FM2 March 2000 ES-4
2.5-deg Equal Angle
Processed : 2000/12/08
File : CER_ES4G2_PFM+FM1+FM2_Edition1_017015.200003
Monthly Mean(Hour)
no data
0
50
100
150
200
250
300
350
Watts/Meter 2

From ceresprd@samantha.larc.nasa.gov Mon Nov 27 09:49:19 2000
Date: Mon, 27 Nov 2000 09:45:55 -0500 (EST)
From: Ceres Production <ceresprd@samantha.larc.nasa.gov>
To: r.n.green@larc.nasa.gov
Subject: QC Report Problem "CER2.2P1" Terra-FM1 (2000-05-25)
Content-Length: 1253

******* KEY ****** KEY ******* KEY ****** KEY ****** KEY *******
*   *
* Present Value = pv   Average = ##_day_avg   *
* Standard Deviation = sdev   Minimum = min   *
K Maximum = max   K
*   *
E Values appear inside { } in the order they are listed.   E
*   *
Y Example ---------- pv < min { 12, 23 }   Y
* This means the present value (12) is less than the minimum   *
* value (23) detected over the tested time span   *
*   *
******* KEY ****** KEY ******* KEY ****** KEY ****** KEY *******

 Page 4 ************************
        TOA LW (Zone=13)
          | pv - 5_day_avg | > 7.0*sdev { 239.000,243.200, 0.400} (ErrQC-800)

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CERES Mechanisms for Conveying QA Results and Validation Status

Product Name (Production Strategy)

- EditionX - may be used for publication
- Alpha/Beta - early release; not for publication

Data Availability Flag

- Data removed from world view if significant problem(s) identified
- If algorithm problem, remove entire version of product and reprocess
- If data problem, remove individual granules; reprocess if recoverable

Quality Summary (http://eosweb.larc.nasa.gov/PRODOCS/ceres/table_ceres.html)

- Required reading before placing initial order
- Describe each product/production strategy combination

Collection Guide (http://asd-www.larc.nasa.gov/ceres/collect_guide/)

- Includes parameter level quality information

Parameter level flag or fill-value

- If parameter instance determined to be of insufficient quality, a parameter level flag set or parameter set to fill-value during production